PCT/GB2004/005404

The Patent Office

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed Andrew Gersey

Dated 20 January 2005

Patents Form 1/77

Patents Act 1977
(Rule 16)

THE PATENT OFFICE
JL
29 DEC 2003
RECEIVED BY FAX

The Patent Office

30DEC03 E862330-1 002835
P01/7700 0.00-0330103.3 ACCOUNT CHA

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office
Cardiff Road
Newport
South Wales
NP10 8QQ

1.	Your reference	JPM/JLM/P550814
2.	Patent application number *(The Patent Office will fill in this part)*	29 DEC 2003 — 0330103.3
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	FAWCETT, CHRISTOPHER 4 PINKS CLOSE LOUGHTON MILTON KEYNES MK5 8FF
	Patents ADP number *(if you know it)*	08506545001
	If the applicant is a corporate body, give the country/state of its incorporation	
4.	Title of the invention	ICE RINK AND TRACK RESURFACING DEVICE
5.	Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	URQUHART-DYKES & LORD Midsummer House 413 Midsummer Boulevard CENTRAL MILTON KEYNES MK9 3BN
	Patents ADP number *(if you know it)*	1644008
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country / Priority application number *(if you know it)* / Date of filing *(day / month / year)*
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application / Date of filing *(day / month / year)*
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))*	NO

Patents Form 1/77

0090149 29-Dec-03 04:35

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	-
Description	10
Claim(s)	-
Abstract	-
Drawing(s)	-

10. If you are also filing any of the following, state how many against each item.

Priority documents	-
Translations of priority documents	-
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	-
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature Urquhart-Dykes & Lord Date 29.12.03
URQUHART-DYKES & LORD

12. Name and daytime telephone number of person to contact in the United Kingdom — JONATHAN P MORRIS - 01908 666645

Warning
After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

f) *For details of the fee and ways to pay please contact the Patent Office.*

Patent for Ice Rink and Track Resurfacing Device

This patent is for a machine which resurfaces ice rinks and tracks (such as may be used in long and short track speed skating), after use, to re-establish a perfectly smooth ice surface. The principle is to melt the top layer of ice, pass the melt through a filter and deposit the melt behind the direction of travel; this then fills irregularities, resulting in a perfectly smooth ice surface after refreezing. The system is normally closed but can be converted to an open system by discarding the melt off ice and replacing with fresh water. Significantly the system allows for sections of the ice to be removed, providing space for insertion or removal of advertising under the ice; this area is then re-flooded and allowed to freeze, re-establishing a perfectly smooth and uninterrupted surface. The system is computer controlled and designed to be fully automatic.

Summary

Currently, most ice rinks and tracks are resurfaced by a machine first invented by Mr Zamboni some 60 years ago. This vehicle scrapes a thin surface layer off the ice, stores the result in a bin and releases water from another tank onto the rink, behind the direction of travel. This floods the area behind the vehicle which then refreezes as a smooth surface. In practice, several runs of the Zamboni and similar machines are required to give a good surface. Also because the rink is resurfaced in strips, the possibility arises for the refreeze to occur at slightly different levels making for a surface which is not perfectly flat, also water can run out of grooves in the ice, not completely filling them, resulting in only a partial repair of the surface. The rink is never resurfaced to the absolute edges of the rink requiring edging from time to time with another machine.

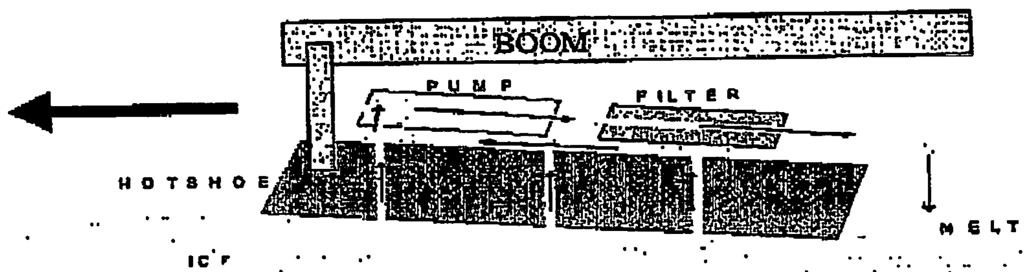
In addition machines of this type require an operator with some skill, considerable servicing in terms of blade sharpness, emptying and filling of bins and refuelling with potentially explosive gas should there be a leak. Considerable space must be provided to house the vehicle and allow access to the rink. These machines are also quite noisy.

These problems are addressed in a new concept in resurfacing using a fully closed system. In this system the ice is first melted, the melt pumped though a filter and returned, clean, to the rink. Ideally rinks should have as good a quality water as possible for their surface, contaminants make the rink slower and this has implications, especially in speed skating. Good quality water, ideally distilled and/or deionised, is too expensive to throw away, hence the need for a closed system. Here good water is cleaned of dust particles and other debris carried onto the rink by users, passed through a filter and returned to the rink. Eventually this surface ice will contain enough dissolved substances to warrant replacement. This is easily achieved by diverting the melt to an off ice tank and discarded, perhaps every month on a heavily used rink, and replaced with fresh good quality water.

This machine, which is in the nature of a boom stretching the width of the rink, is stored in the rink area, variously, depending on the model, so requiring no off ice storage space. It is relatively small in bulk, is unobtrusive and relatively silent in operation.

The ice is resurfaced to the very edges of the rink, the surface ice is simultaneously melted across the entire width of the rink, making for a perfect surface, both in terms of flatness and filling of surface grooves, after resurfacing. All surface particulate matter is removed to 5 microns in size. Gross materials, such as wrappers, are pushed to the end of the rink where they are removed manually, before the melt refreezes, this however is usually not necessary.

The principle:

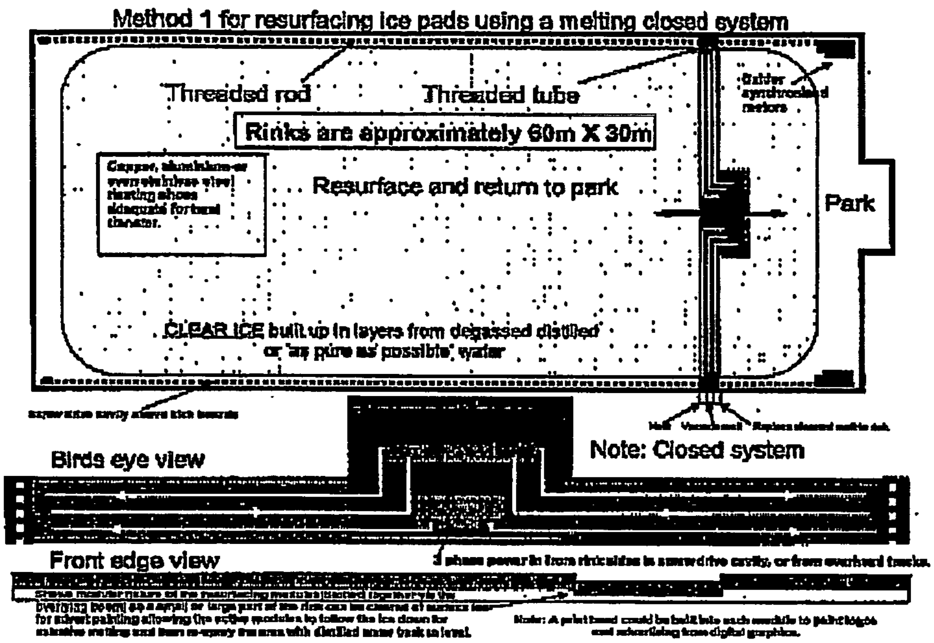


A system of modular or continuous hotshoes are arranged across the rink and are then moved down the rink by a boom which may be driven from above the rink, the sides of the rink, the end of the rink or self driven from motors and ice wheels on the boom itself.

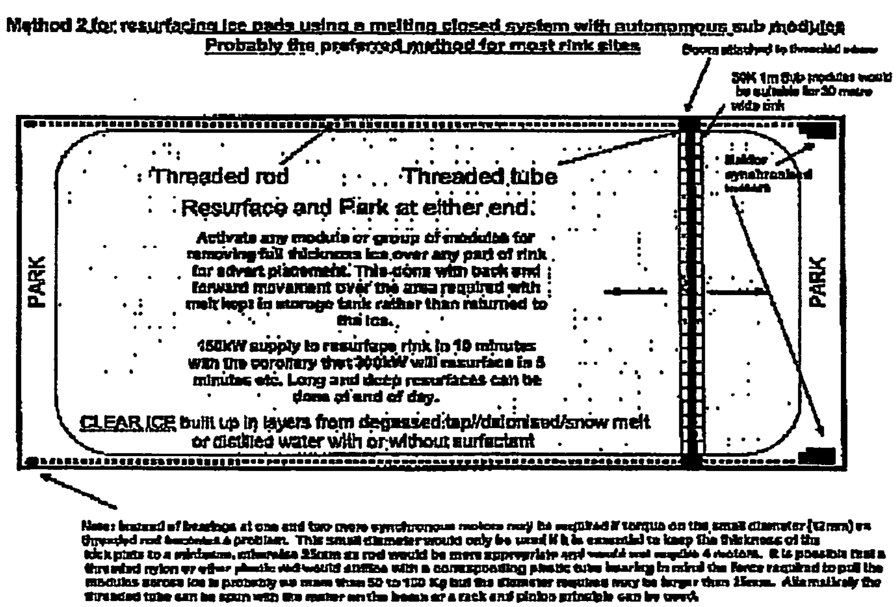
The hotshoes melts the ice to a depth more or less than 1 mm, this melt, which is potentially dirty is sucked off the rink by a dirt tolerant pump, passed through a filter and returned to the rink behind the boom. The entire width of the rink is resurfaced simultaneously so that all the defects are filled entirely by the melt, which on re-freezing results in a perfect surface.

A corollary to this is to progressively melt through a part of the rink by activating part of the row of modules and passing them backwards and forwards over a section of the ice, progressively melting through the ice until practically down to concrete. At this stage the ice is painted or a transfer or other advert or picture is laid in the hole and covered with the saved melt or fresh water to re-establish an even and flat rink. By this means adverts are easily placed or removed from an ice rink thus being able to be sold on both a short or a long term basis.

Detail



In this scheme, the water is processed in the centre of the boom with one pump and one filter, however the system must still be modular in terms of the heating elements is sections of the rink are to be de-iced for the purpose of inserting advertising, logos or the like. This system works well when drive for the boom is provided from the edges of the rink. It is necessary to have parking which is suitable for the size of a central pump and filter, this will often mean considerable modification of the rink surrounds for existing rinks so better suits rinks purpose built, with this type of resurfacing in mind.



even if the surrounds to the rink are to be modified a more satisfactory solution would in most cases mean that each submodule should be autonomous with its own filter and pump. This allows for considerable redundancy and easy replacement of a complete submodule should there be a pump or element failure.

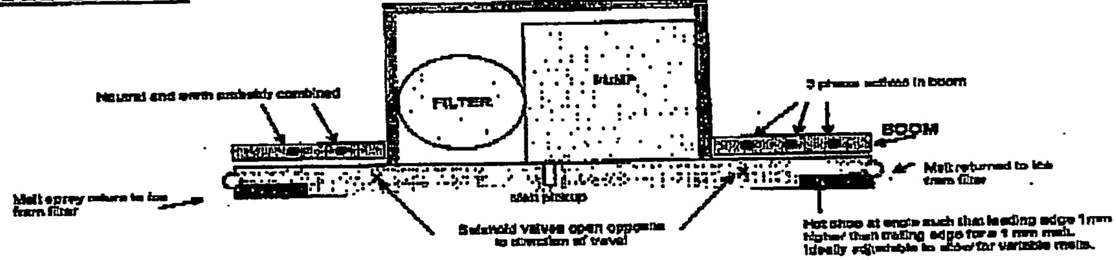
The rink barrier at either one or both ends would only require the kick boards to be raised and lowered to allow parking of the device before and after resurfacing. In this configuration, the boom and modules will fit through a vertical gap of 200mm.

The Boom:

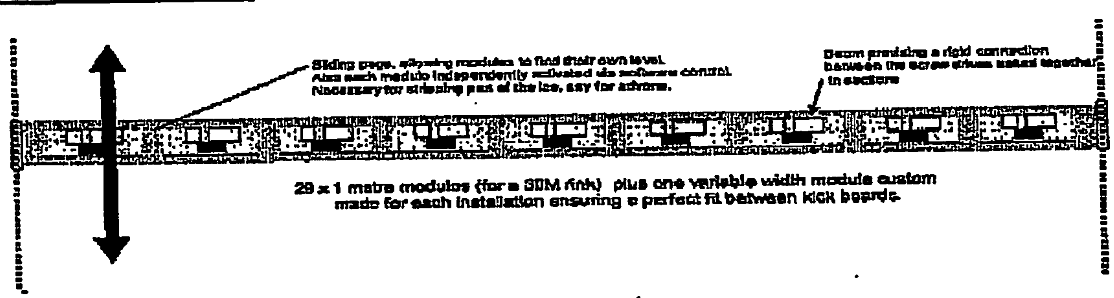
In the above models the boom is merely a mechanical joining device being a rigid structure, driven at both ends by synchronous servo motors and attached to the hotshoe by free floating pins allowing for vertical movement of at least 25mm (the depth of ice which may have to be removed in sections for advert, logo or similar placement). By this method all modules are pushed forward together down the rink.

A single or multiple pumping devices and filters are assigned to each module (depending on whether there is a height restriction for parking under the kick plate gap). These filters and pumps can either be mounted on the hotshoe or on the boom above the submodule.

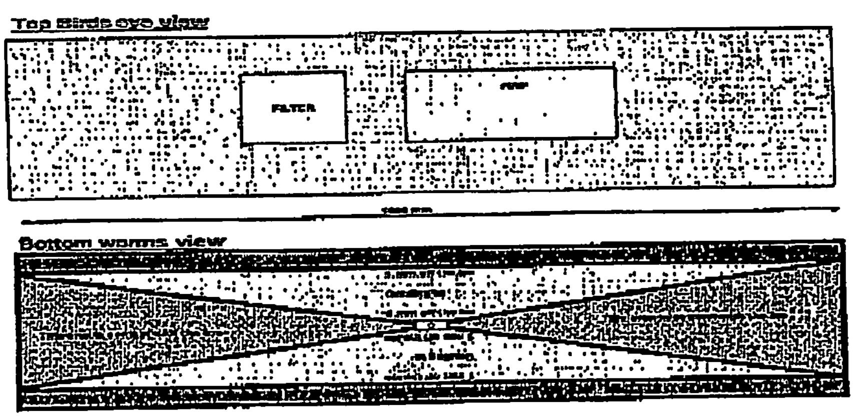
Side Cross Section



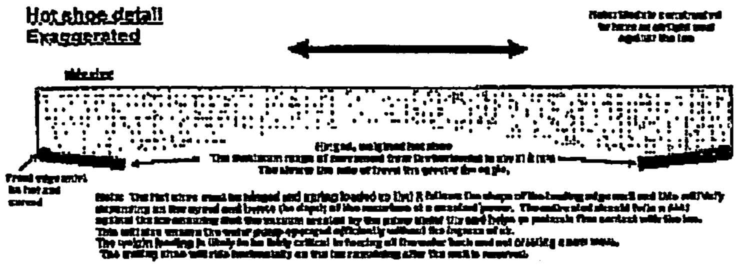
Birds Eye Rink View



The Module:



Has a hotshoe in both directions of travel, this being necessary for a forward and backward motion over sections of the ice to successfully dig holes for adverts etc. Between these is an area where the melt is channelled to a central point and picked up by the pump/filter system, the clean melt being then returned to the rink in a normal resurface, or taken off ice where holes are being made for advertising etc.



Laterally the modules are simply butted against each other, the alignment being maintained by the floating boom pegs.

The depth of resurfacing is governed by the available power and the speed of travel of the boom down the rink. Approximately one calorie per gram is required to raise the ice and the melt water one degree centigrade and 80 calories per gram to overcome the latent heat of melting. The melt should be heated to 15 degrees C so a proper bond is formed with the remaining ice (rather than a lamination); the surface ice will usually be between 4 and 7 degrees C below freezing before resurfacing, thus the heat requirement for each gram of ice will be 80 + about 20 calories or 100 calories in total.

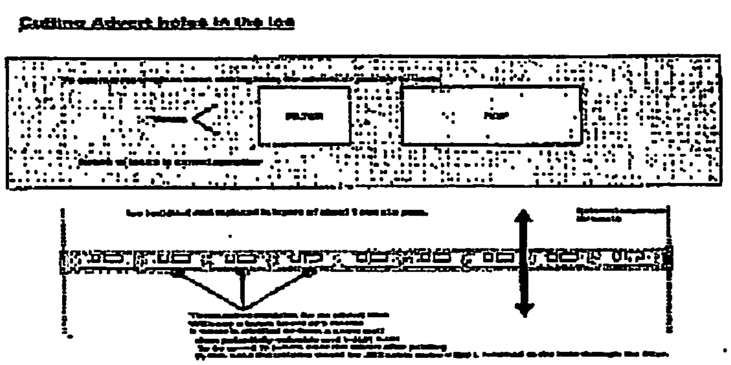
To resurface the top 1.00mm of an Olympic rink requires the melting of 1.8 cu metres of ice producing 1,800 litres of water requiring 1.8 x10^{8} calories or 7.5 x 10^{8} joules of energy. If the resurfacing is to be completed in one hour then 200 kw of electrical power must be available. This represents a very deep resurface which may be resorted to on very damaged or polluted ice, from time to time, at the end of the day. This represents 200 units (kw/hr) of electrical power which may cost £20 where electricity is expensive.

A normal resurface only needs to produce 1/10 of this in melt or 180 L, as it is only necessary to fill the defects and produce an even wetting of the surface which is aided by a little surfactant in the melt to reduce the surface tension effects around defects. The original surface does require being perfectly flat which may take a deep resurface to achieve initially.

Thus an average resurface on an available electrical supply of 200 kw will take about 6 minutes and cost about £2. This overhead is considerably less than the overheads required to run a Zamboni type machine.

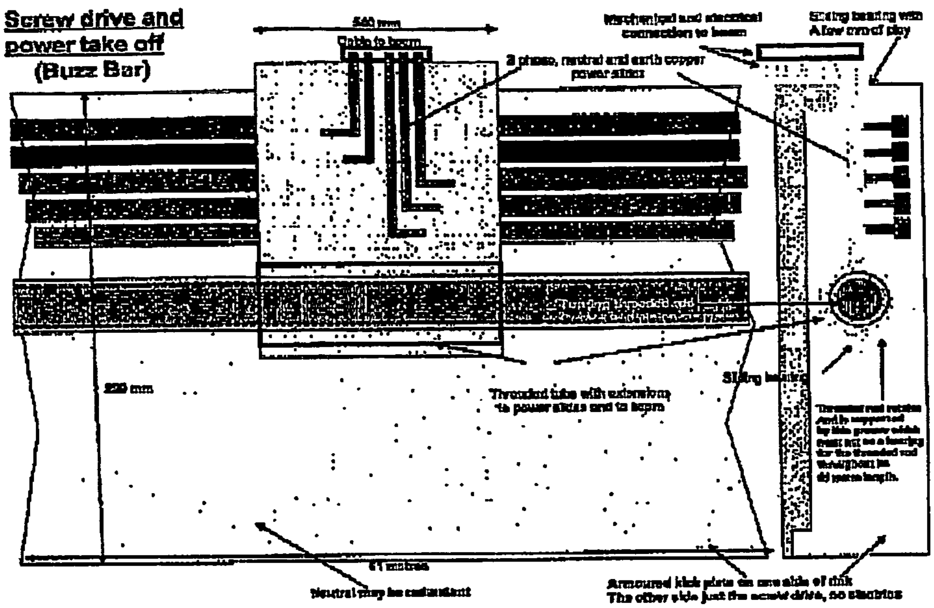
Often ice rinks have a high voltage electrical supply which usually means that up to a megawatt of power is available, 800 kw could easily be applied by this device, so potentially a normal resurface could be achieved in 1.5 minutes or a deep resurface in 15 minutes with various depths of resurface between.

Laying advertising in the ice:



This is a very important source of revenue for many rinks, where potentially advertising can be sold on a weekly, monthly, seasonal or annual basis. For short periods it is essential that the adverts can be placed simply and quickly. This is quite difficult for a Zamboni machine but simple for this type if machine. The ice can be melted to desired depth with a backwards and forward motion controlled by the software.

Getting power to the modules:

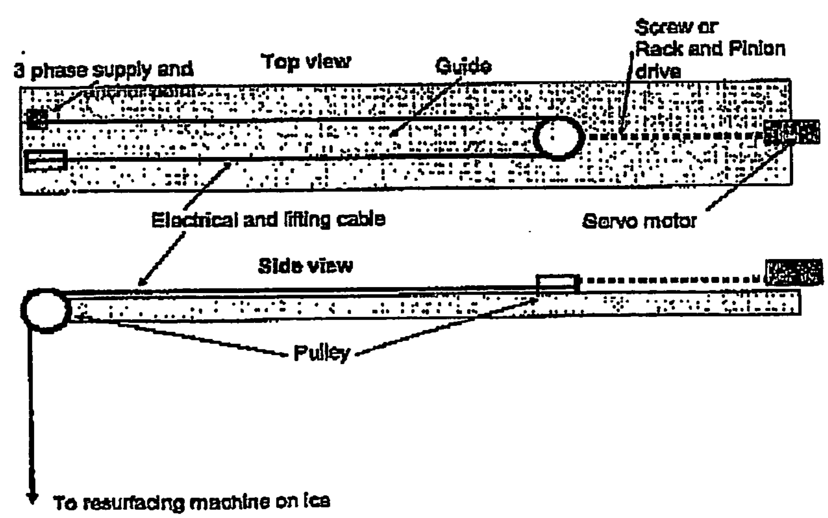


Different methods must be used to supply power to the heating elements as well as the pumps, servo motors and other electronics, depending on how the machine is stored. This may be at the end of the rink, behind the kickboard where rink modification is possible or in the case of new rinks. Existing rinks where it would be difficult to modify the rink surround would use the roof space for storage of a somewhat different system.

Where possible trailing cable is to be avoided, so where a boom is driven from the sides of the rink a buzz bar similar to the one shown above, would travel the length of the rink behind the kick boards. Power is taken from the bars by slides and distributed via the boom to the various modules.

In the case where no modifications can be made to the existing rink, the machine would be stored in the roof space, as described in the next section, and power would be fed from the roof space. Again a buzz bar system is the most elegant, where one or more vertical cables follow the machine down the ice, deriving power from buzz bars in the ceiling space.

Often rinks have obstruction to the clear passage of a cable down the rink such as wires across the rink to support nets and the suchlike. Here the cable must descend with the machine and trail behind it on the ice; the following scheme is appropriate.

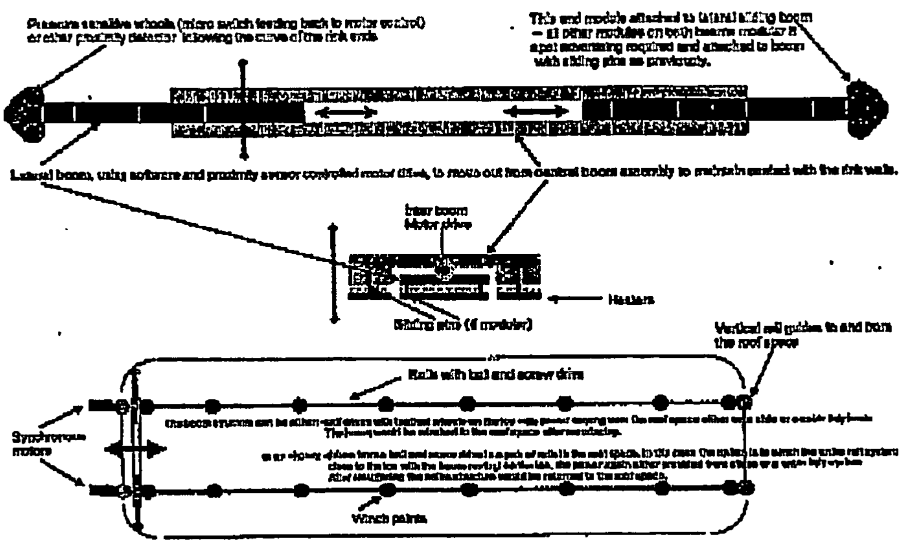


The servo motor is synchronised with the boom motors so that cable is paid out appropriately as the boom moves down the rink.

If the boom and modules are to be lifted into the roof space, then a lifting cable will be combined with the electrical cable. The most convenient system will usually have two of these pulley systems, one for each side of the boom, this way the electrical supply is split between two cables, each being more flexible than a single supply cable, being particularly important should very high powers be used.

Often it is not an option to modify the existing rink; in this case the resurfacing machine should be self propelling and self aligning. In addition the curved corners of the rink must be catered for in a fully automatic fashion.

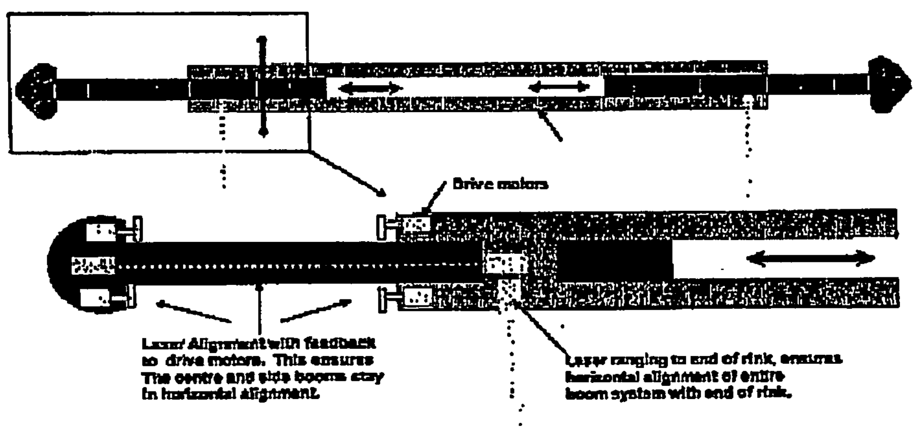
System where no rink modification required



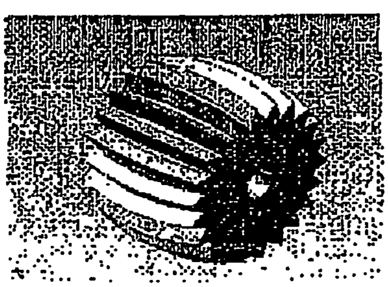
This is done, as shown, using a two booms within a boom. The outer booms are driven by a central linear drive against the barrier walls, moving out as the boom system moves away from an end barrier and moving in as approaching an end barrier.

The outer booms may be behind or in front of the central boom as well as within it. They must be independently driven at their periphery otherwise the leverage on the central boom would be too large; the boom system is kept in horizontal alignment by lasers feeding back to the motor control system.

The boom system itself is horizontally aligned with the ends of the rink with another laser ranging system feeding back to the drive motor control system.

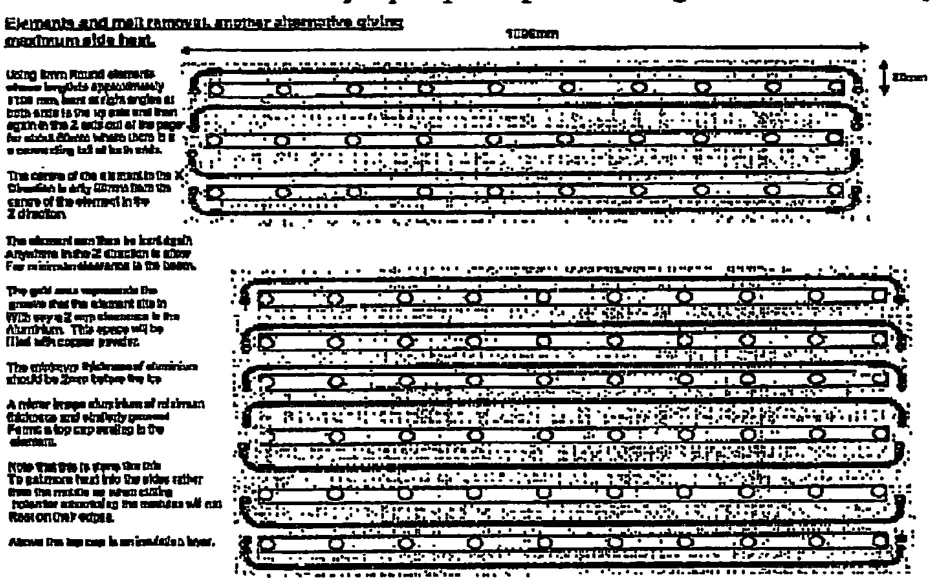


Shown are two motors in each drive position. In fact one drive motor would drive two ice wheels. These being specially designed to grip ice in the backward and forward direction but slide freely in the sideways direction.



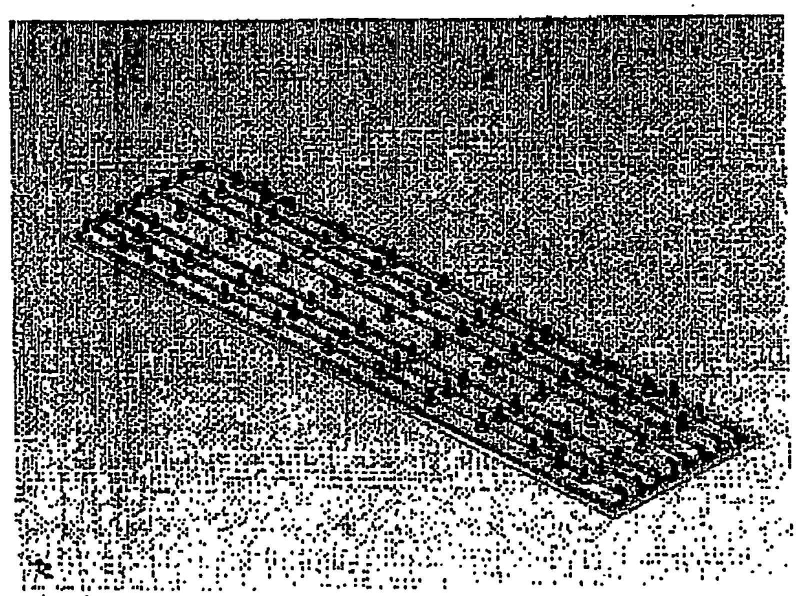
The Heating element and filter system

In concept, the ice must be melted by the application of power through an electrical heating element, after which the melt is removed by a pump and passed though a filter and re-deposited on the rink behind the advancing resurfacing machine. Finally the melt is pushed up into a layer approximately one or two millimetres thick by a trailing barrier which allows for complete filling of the defects in the ice, prior to refreezing. By using this technique the amount of ice required to be melted is reduced to a minimum.



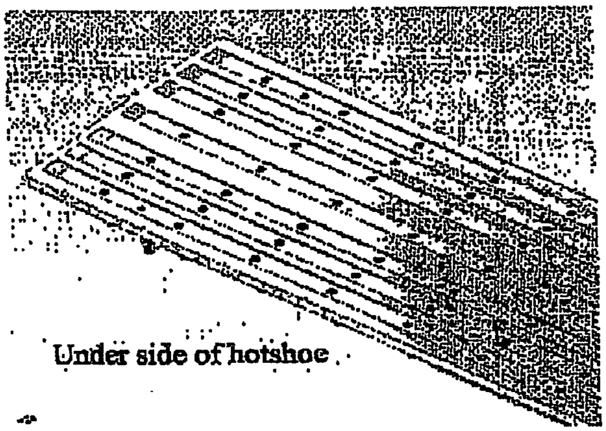
A method for gathering the melt prior to filtration has already been described. A different layout is here described which allows for the melt to be extracted in the same gross space as occupied by the element. The partial vacuum produced by the pump holds the hotshoe firmly in contact with the ice. The melt pump may be of several types, some pumps such as vane and piston pumps are usually not tolerant of particulate matter and require pre-filtration, whereas peristaltic pumps are very tolerant of particulate matter and do not require pre-filtration. In any event the pumps must be self priming and happy to run without continuous water flow.

Filtration is required to clean the rink surface, typically rinks are resurfaced four times a day but may be up to twice this. At the end of the days activities, the final resurface should be slow and deep, up to 1mm in depth, with plenty of time for re-freezing overnight. This ensures a perfect surface for the start of the next day. All dirt particles above 5 microns in size should be removed. Gross objects, such as sweets, are pushed to the end of the rink by the machine and are easily removed manually.



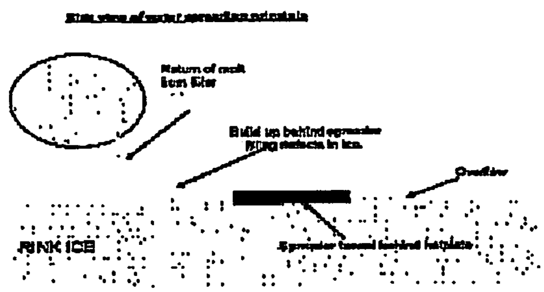
Shown is the top side of the aluminium hot shoe, heating elements are bedded in slots with 50 micron copper powder. Under the shoe slots are cut to collect and remove the melt. The nipples shown are connected to a manifold which leads to the pump which forces the melt through a filter and back to the rink through a slot in the

trailing edge of the hot shoe. The vertical pins, shown, pass through matching holes in the boom; this method of connection allows each module to find its own level, necessary for cutting deep holes for adverts.



Under side of hotshoe

Trailing the hotshoe is a melt spreader, no more than two mm high, this device builds a depth of melt in front of it, breaking the surface tension effect of ice defects and allowing their complete filling by the cleaned melt. If it were not for this device far more ice would have to be melted to create a continuous lake from edge to edge of the rink – necessary for a perfect surface following refreezing.



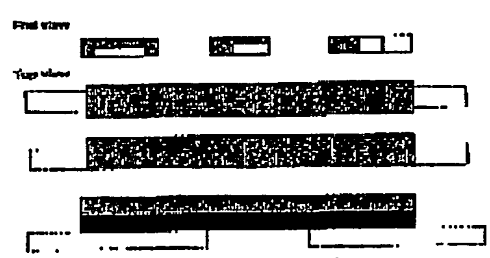
The Triple Boom

Previously briefly described, a central boom is attached through a linear drive to two lateral booms, as the boom moves away from the end of the rink the two lateral booms are forced outwards so the ends of these booms maintain contact with the kick plates on the barriers.

If the boom together with its hot shoe modules is to be stored behind the kick plates across the whole width of the rink, then it can be a single boom although it may be made of several sections for convenience. This however has a downside; all rinks have curved corners, which means considerable work in the corners of the rink as the space behind the corner kickboard is large to accommodate a single piece boom together with its drive system.

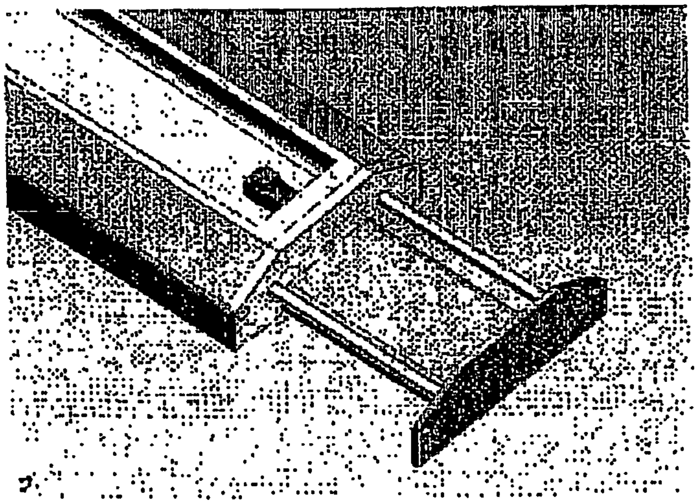
It will usually be far better to provide parking accommodation only behind the straight centre section at one end of the rink, which means the space required is only the width of the machine, approximately 500mm. Also if the machine is to be stored in the roof space, where no rink modification is necessary, then again the triple boom is required to get into the corners and so cover the entire surface of the ice to the edges.

The boom can be of several configurations depending on what type of linear drive is used, the peripheral booms can be enclosed within the central boom or adjacent to it or separated from it by a centre section which carries all the electronics.



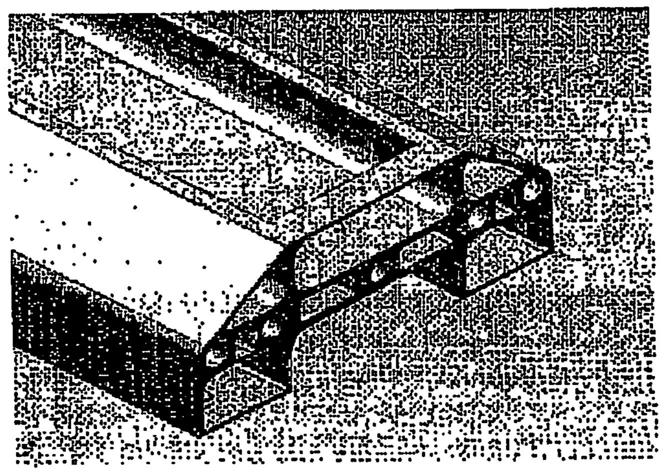
As previously noted alignment of the centre section with the lateral sections and alignment of the whole boom with the rink is done in real time with lasers, this being necessary because of the possibility of slippage of the wheels on the ice.

Generally it will be convenient to have the hot shoe carrying only the heating elements, and the booms carrying the filters and pumps (one or more to each heating module). The central boom will also carry the motor amplifiers, controllers and PLC, together with the lasers, making for a fully automatic system.

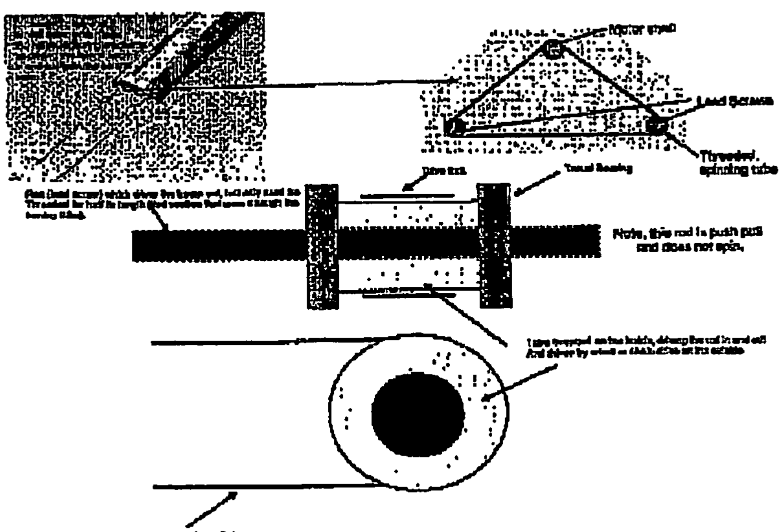


The drawing on the left illustrates one side of the boom assembly showing the linear drive extending the lateral boom.

Below is shown the type of aluminium extrusion necessary for the boom structure



The centre section of the middle boom contains the linear drive mechanism which may be a ball and screw arrangement as shown below. It is important for stability that the drive rods travel the full length of boom when the lateral booms are retracted so half on them remains within the boom when fully extended.



Different types of linear drive are available to handle this task, a rack and pinion type of drive would also be suitable.

The Software

As this entire system is designed to be fully automatic the sequence of events and control of the various motors, pumps and heating elements together with integration of locating micro switches and laser positioning devices falls to a programmable logic controller (PLC).

The software also carries out several safety functions, if torque loadings on motors goes too high then the entire system is switched off, if the system goes out of alignment, then similarly it is switched off and manually recovered. If the system is not properly locked in place at its parking destination a warning will sound and be displayed. In principle lasers are responsible for alignment, micro switches and motor torque levels make sure the booms are fully extended to the rink barriers and motor rpm govern the speed of movement.

Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/GB04/005404

International filing date: 29 December 2004 (29.12.2004)

Document type: Certified copy of priority document

Document details: Country/Office: GB
Number: 0330103.3
Filing date: 29 December 2003 (29.12.2003)

Date of receipt at the International Bureau: 08 February 2005 (08.02.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse